

# GEO ENeRGY

Promoting *R&D capability* in the service of European Industry

## Geothermal Energy Application Experience and Development in Europe

Europe is definitely the most geothermal continent in the world (Fig. 1), at least where direct application is concerned. Twenty nine European countries account for about 45% of total flow, 40% of total installed capacity and 50% of annual utilization. However, distribution of the “know-how” and experience is still very uneven. Heat pumps are most common in northern and western European countries where geothermal energy is mainly used for space heating purposes. Balneology is typical of central Europe. Agricultural and industrial uses are spread throughout the southern and eastern countries. An exception is Iceland, where nearly all the known types of direct utilization can be found.



Electricity production is highly developed only in Iceland (Fig. 2), where it accounts for a significant part of the country's total consumption. A small electricity plant also exists in Turkey since about 20 years. However, the appearance of new production technologies enabling the use of lower temperature geothermal brines has opened up new development possibilities. Two plants are already in production in Germany, one is under

development in Hungary, and positive possibilities for completion are foreseen in Greece, Serbia, Croatia and other countries. The first power plant based on the “hot dry rock” technology was completed last year in France.

The most famous example of geothermal space heating is the district heating system of Reykjavik in Iceland (Fig. 3), covering all the heating needs of the town. Besides those in Iceland, the major district heating system in Paris is also renowned, as are those of Kocani (Macedonia), Ferrara (Italy), Zakopane (Poland) and two new smaller ones in Germany.

The district heating technology is the most widespread in Turkey, where about 65,000 apartments are heated by



Fig. 1: Distribution of geothermal energy application in Europe. The figures depict the amount of geothermal energy utilization (GWh/year) in the particular country.



Fig. 2: The Nesjavellir geothermal power plant (Iceland). Photo courtesy of Gretar Ivarsson.



Fig. 3: The geothermal district heating system of Reykjavik (Iceland). Photo courtesy of Icelandic Tourist Board.

geothermal energy. New developments are in progress or expected in Germany, Slovakia and other European countries.

Geothermal energy application in agriculture is mostly related to greenhouse heating. Large complexes exist in Hungary, Macedonia, Iceland and Russia, plus some smaller units in Greece and other Mediterranean countries (Fig. 4). These offer highly competitive substitution of expensive fossil fuels. After 20 years of stagnation, a new process of development is underway in countries such as Romania, Slovakia, Hungary, and Bulgaria. Interesting and successful experience has been gained with the production of algae spirulina (Fig. 5) in Bulgaria and Greece, and in open field heating for growing asparagus in Greece, opening up possibilities for new developments in the agricultural sector.

Successful experiences can also be listed in the industrial sector, such as tomato drying (Fig. 6) in Greece, grain drying in Hungary and Macedonia, wood drying in Poland, and several different uses in Iceland and Romania. The food processing sector is a highly prospective field for development of this type of geothermal energy use.

Fish farming of various species has been successful in ponds



Fig. 4: Geothermally heated greenhouses in Nigrita (Greece)



Fig. 5: Production of algae spirulina in Xanthi (Greece)

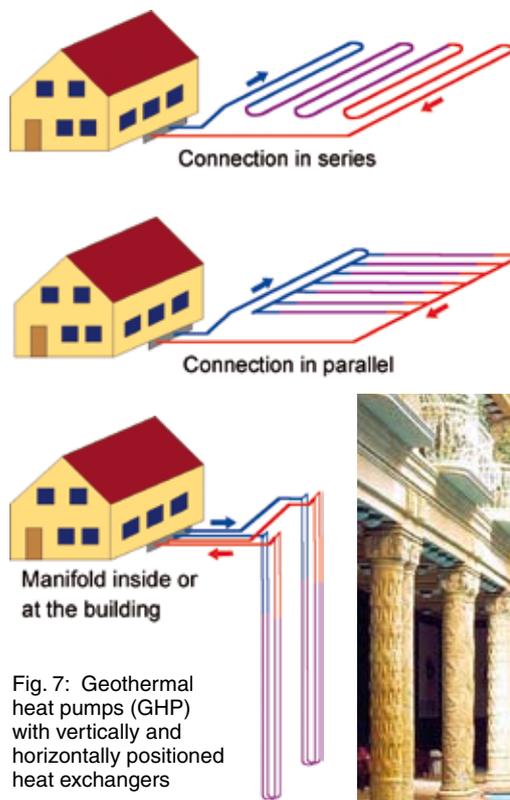


Fig. 7: Geothermal heat pumps (GHP) with vertically and horizontally positioned heat exchangers

heated by geothermal water in France, Hungary, Italy, Serbia, etc. Open market possibilities can be foreseen in most of the Mediterranean and some eastern European countries.

During the past two decades, geothermal heat pumps (GHP) are the type of direct geothermal energy use with the highest rate of development, particularly in northern and central European countries, mainly because they offer independence even for small-scale users. The different types of heat exchangers (Fig. 7) mean that they can be adapted to local conditions.

Last but not least, the oldest type of geothermal use – balneology, has seen a comeback through the introduction of recreational and tourist facilities in addition to the classical healing ones (Fig. 8).

The experiences listed do not represent all the possibilities for useful geothermal application in the various sectors, but they do illustrate that a very prospective energy source is in question, which can play an important role in energy balances of many European countries, particularly for the part of heat consumption. It is, therefore, strange that only a minor part of the resource available is actually put to use.

The reasons for the limited and slow development can be attributed to the complex character of the geothermal energy source and associated exploitation technologies, the



Fig. 6: Drying tomatoes with geothermal energy in Xanthi (Greece)



Fig. 8: The famous Gellért Spa in Budapest (Hungary). Photo courtesy of [www.budapestinfo.hu](http://www.budapestinfo.hu).

high investment costs in source identification, completion and development, the site-specific character and the absence of proper treatment in most European countries. Iceland is probably the only country that understands just how important this energy source is, and where its development is supported by all the necessary legal, organizational and financial measures. The positive results of such politics are obvious.

Considering the recent development of fossil fuel prices at world level and the high European dependence on import, and based on the consequences of the first energy crisis of the 1970s (when the real wider development of geothermal energy use began), it is possible to expect a more rapid development in the future, together with the other renewable energy sources. This time, it will also be supported by environmental requirements, conditioned by strict European legislative and concrete obligations for each of the EC members. The first positive signs can be seen in Germany, Hungary, Austria, Romania and France and it looks like this trend will be followed in Croatia, Slovenia and Italy.

Appearance of the new geothermal district heating

systems with cogeneration (common production of power and heat) in central European regions will have a highly positive influence on the development process in general. These systems will illustrate possibilities of overcoming the main part of present constraints by offering users the option of switching "on/off" supply (and thus payment), depending on the quantity of heat or power needed. Furthermore, a high increase in food prices should underline proven advantages of geothermal energy use in Mediterranean and southern and eastern European countries and, with this, better possibilities for the development of uses in industry, particularly in the food processing sector.

Success and intensification of development depends crucially on the intensification of the dissemination of information for positive experiences and possibilities in order to be understood and accepted by decision makers and relevant stakeholders. Also important is the development of international collaboration, in order to enable dissemination of experience and make available new "know-how" to other countries lacking in this domain.

Kiril Popovski  
& George Hatziyannis

# ENeRG Sponsored EEF Lunch Debate on Geo-Energy

ENeRG sponsored a Lunch Debate entitled "R&D opportunities in geo-energy and CCS" organized by the European Energy Forum on 25 March at the European Parliament in Strasbourg. The opening speech was imparted by Mr. Roberto Martínez, president of ENeRG, which was also represented by Mr. Sergio Persoglia and Dr. Alla Shogenova. Proposed issues for the debate described in the opening speech included:

- Research in geo-energy after the new EU strategy on 20-20-20
- Hydrocarbon systems and security of supply

- Clean coal as a valuable energy source
- Geothermal energy, a hot topic in many European countries
- Geological storage of CO<sub>2</sub>
- Research and technological development to fight the crisis in sectors supporting tens of thousands of employees in Europe.

In all, 24 people attended the debate, including 15 Members of the European Parliament and representatives of European industry. Interest of the MEPs was mainly focused on CCS but some questions on other issues were also answered by ENeRG representatives.



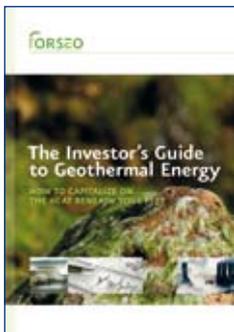
ENeRG newsletter issues were distributed to attendees and were highly appreciated. As a result, ENeRG has been promoted as an actor in the European Parliament energy

scene and has been invited to participate in future debates and to come back to EEF in the future.

*Roberto Martínez Orío*

## How to Capitalize on the Heat beneath Your Feet

### The Investor's Guide to Geothermal Energy



Forseo's publication "The Investor's Guide to Geothermal Energy" provides comprehensive and market-driven insight into all important aspects of geothermal business and project development. It serves as a practical reference tool for the financial community, for stakeholders from the industry, and for those ready to enter the geothermal energy market. Many experts share

their experience to make this publication the first of its kind.

Investors' interest in geothermal technology is finally catching on and the number of those recognising the huge geothermal potential to be tapped is ever increasing. Some recent developments have triggered this new interest.

The Investor's Guide to Geothermal Energy introduces

the most important aspects, challenges and solutions of geothermal business and development.

The International Geothermal Association (IGA), the European Geothermal Energy Council (EGEC) and UNEP's Sustainable Energy Finance Initiative (SEFI) have endorsed the publication.

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## CO<sub>2</sub>GeoNet Open Forum, 18–20 March 2009: a Major International Event

CO<sub>2</sub>GeoNet – Europe's Network of Excellence on the geological storage of CO<sub>2</sub> – held its fourth and final Open Forum under the FP6 EC contract in Venice on 18-20 March 2009. The objective was to present highlights from five years of research and development carried out by hundreds of scientists and to interact with stakeholders on the future needs to be addressed by science.

This Open Forum was a major international event with an audience of policy-makers, public authorities, industry executives, regulators, academia, NGOs, EC

representatives, engineers and scientists. Some 150 participants attended from 24 countries across Europe, Australia, Canada, Iran, Japan and the USA.

Stakeholders were given the opportunity to:

- share the highlights from five years of collaborative research, carried out by hundreds of scientists from the 13 CO<sub>2</sub>GeoNet member institutes, focusing on four topical questions:
  1. What have we learnt about the behaviour of the storage complex?
  2. Enhanced hydrocarbon recovery: is it still an option

for CO<sub>2</sub> storage?

3. Can we detect and quantify CO<sub>2</sub> leakage at ground surface and sea bottom?
4. What if CO<sub>2</sub> reaches the surface?

- hear concrete examples of international developments on CO<sub>2</sub> storage from invited high-level speakers
- discuss and help shape the future plans for the CO<sub>2</sub>GeoNet Association, now an established scientific association under French law, concentrating on CO<sub>2</sub>GeoNet's four areas of activity: training and capacity building, scientific advice, research, information and communication.

The most successful result of this EC-founded Network of Excellence is the transformation of CO<sub>2</sub>GeoNet into a legal entity. CO<sub>2</sub>GeoNet has become the European scientific authority on the geological storage of CO<sub>2</sub>, needed to accelerate the deployment of and build confidence in CO<sub>2</sub> storage.

Venice presentations are available for downloading at: [www.co2geonet.eu](http://www.co2geonet.eu).

*Isabelle Czernichowski-Lauriol*



**ENeRG - European Network for Research in Geo-Energy** – is an informal contact network open to all European organisations with a primary mission and objective to conduct basic and applied research and technological activities related to the exploration and production of energy sources derived from the Earth's crust.

**ENeRG president** for 2009 is Dr. Roberto Martínez Orío from the Geological Survey of Spain (IGME). Contact: [ro.martinez@igme.es](mailto:ro.martinez@igme.es)

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**ENeRG website:** <<http://www.energnet.eu>> is maintained by the Institute of Geology at Tallinn University of Technology, Estonia.

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**ENeRG Newsletter – GEO ENeRGY**

The Newsletter is published by the Czech Geological Survey (CGS), Prague, Czech Republic.

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# GEO ENeRG Country Profile – FYR Macedonia



## ENeRG member & country representative

MAGA – the Macedonian Geothermal Association – is a professional association of engineers and scientists working in the field of renewable energy development, particularly geothermal energy. It is registered for research, development, education and knowledge dissemination both in the FYR Macedonia and worldwide. Since 1989, it has been running the International Summer School on the Direct Application of Geothermal Energy, the only school recognized by the International Geothermal Association (IGA). Each year, it also organizes short courses, seminars and workshops all over Europe, even farther afield (1 course in the USA). MAGA is highly active in European Research and Development projects, not only in geothermal energy, but

also in the biomass and solar energy sectors.

## Other institutions

The Faculty of Geology and Mining of the Goce Delcev University in Shtip has carried out some initial investigations in the field of geothermal energy research and intends to progress deeper if support is awarded from state or private resources.

Unfortunately, the Geological Survey of Macedonia, which was very active in this field, no longer exists.

## Main activities in the field of geo-energy

The process of political and economic transition has had a negative impact on the activities in the field of geo-energy in FYR Macedonia. Practically no new investigations have been undertaken since 1990. Even more drastic, the largest geothermal project in the country was abandoned following privatization of the user. The few recent efforts focused on keeping the existing projects going. Nevertheless, with the help of the Austrian

Development Agency (ADA), the geothermal district heating project in Kocani has been improved by introducing reinjection of the waste water, thus preventing the water level in the reservoir from falling. The privatization of spas initiated actions for their reconstruction and modernization, although this is a slow process due to the lack of interest from national and international investors. Despite this, one spa has been equipped with geothermal central heating and others are currently under reconstruction.

The main problem holding back the revival of geothermal development in FYR Macedonia is that the state does not have a defined development policy or strategy.

According to investigations made in the 1980s, the geothermal potential of existing natural springs and wells in FYR Macedonia is about 173 MWt, of which only some 60 MWt is utilized, with an annual heat production of about 600 TJ/yr. No relevant estimation of geothermal energy reserves of the country exists.

FYR Macedonia's coal reserves are very important in terms of consumption, accounting for almost 51.6% of the country's total energy consumption and 83% of electricity consumption. The remaining 17% is provided by hydro-energy and importation. The lack of investigations and investments in the development of this energy resource has resulted in the present negative situation where known reserves are expected to last only about 10 years at the current level of exploitation.

## Research on CO<sub>2</sub> geological storage

Due to the collapse of the industrial sector, FYR Macedonia is considered to have a relatively low level of CO<sub>2</sub> emissions. The Ministry of the Environment organized the collection of data on the level and distribution of CO<sub>2</sub> emissions, as also done by MAGA in the framework of the EU GeoCapacity project. However, no further actions have been taken to investigate possibilities for CO<sub>2</sub> geological storage, whether classical or mineral sequestration.

*Kiril Popovski*

## ENeRG Student Prize Awards

H. Karimaie (NTNU, Norway) and Z. Qian (British Geological Survey) won the ENeRG student prizes for the best student paper

and poster at the EAGE/SPE EUROPEC 2008 conference in Rome. ENeRG will again award these prizes, worth 1,000 euros each, at the EAGE conference in Amsterdam (8–11 June 2009).

## The ENeRG Network

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